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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

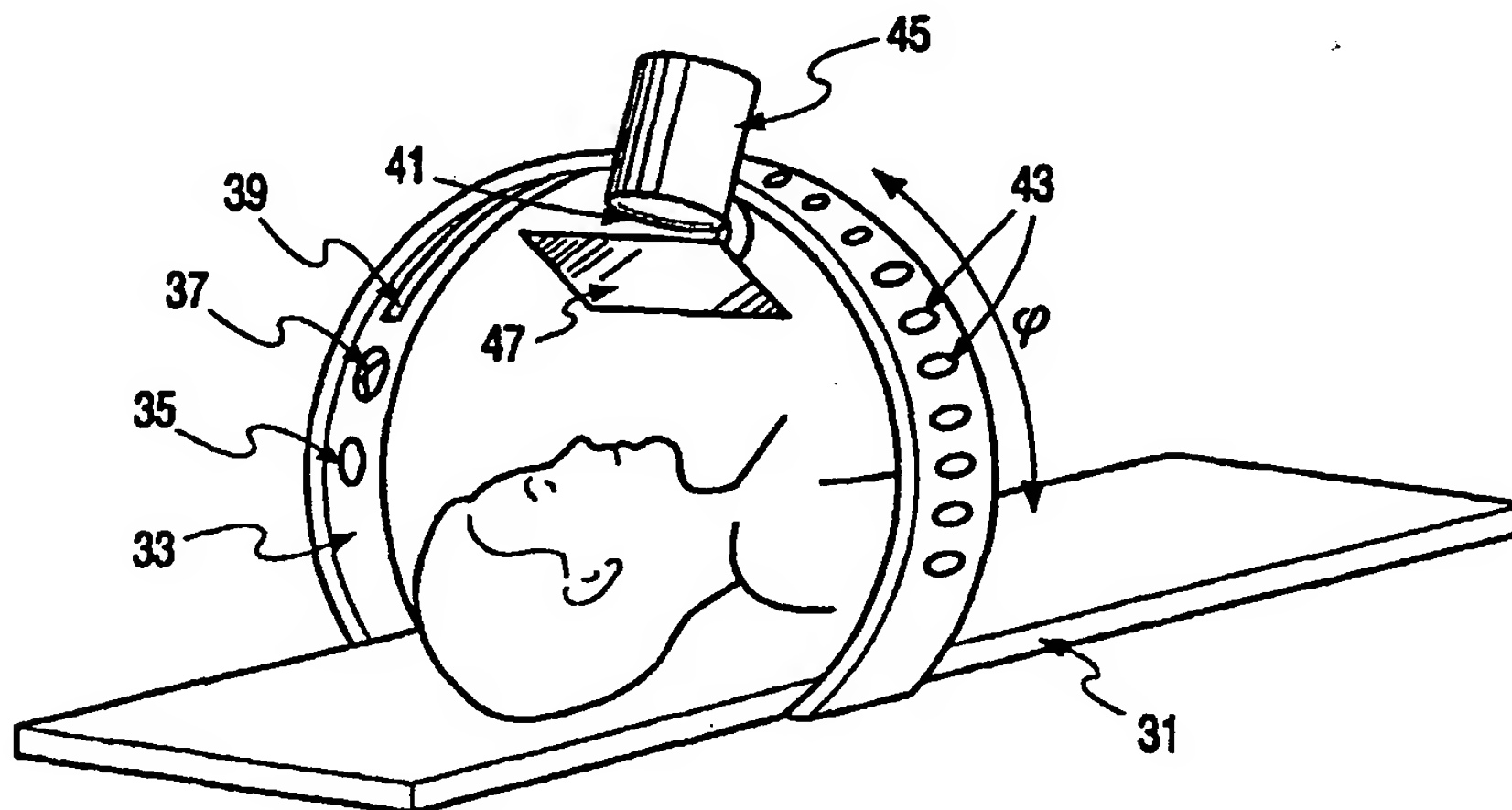
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- (71) Applicant: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).
- (72) Inventors: KISTEMAKER, François, M.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). VRIJHEID, Johan, E., W.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MAGNETIC RESONANCE IMAGING APPARATUS INCLUDING A COMFORT ZONE



(57) Abstract: A magnetic resonance apparatus includes an imaging volume and a patient table that can be arranged in the imaging volume. The apparatus is provided with means enabling communication between a patient arranged on the table top in the imaging volume and the outside world. A carrier is mounted on the patient table at the area of the head of the patient. Attached to the carrier are said communication means as well as means for communication between the outside world and the patient on the table in the imaging volume and/or means for enhancing the patient's comfort.

Magnetic resonance imaging apparatus including a comfort zone.

The invention relates to a magnetic resonance imaging apparatus which includes a measuring space and a patient table which can be positioned in the measuring space, means being provided so as to enable communication between a patient arranged on the table in the measuring space and the outside world.

5 An apparatus of this kind is known from United States patent No. 5,150,710 in which a system of mirrors is mounted on the patient table so as to enable a patient arranged on the table to maintain visual contact with the outside world after the table has been positioned in the measuring space of the MRI apparatus. United States patent No. 5,825,563, moreover, discloses a mirror which is attached to an arm which is mounted on the patient
10 table to be positioned in the measuring space. The limited space available in the MRI apparatus imposes considerable restrictions on the separate mounting of such a communication means directly on the patient table.

A magnetic resonance imaging apparatus for medical purposes, also referred to as an MRI apparatus, is arranged to form images of cross-sections or so-called slices of a
15 body. To this end, in such an apparatus a strong, steady, uniform magnetic field is generated in a volume which is intended for imaging, that is, the imaging volume. A magnetic gradient field is superposed on said uniform field in order to indicate the location of the slice to be imaged. The atoms in the tissue present in the imaging volume are then excited by means of an RF field; the spin resonance signal formed upon relaxation of the excited atoms is then
20 used to reconstruct an image of the slice indicated by means of the gradient field. The steady uniform field, also referred to as the main field, is generated by means of a coil system (superconducting or not). This coil system and the associated envelope together may be shaped as a short tube in which the imaging volume is situated. The diameter of this tube is determined by the dimensions of the patients to be examined and hence has a given minimum
25 value, for example of the order of magnitude of 90 cm. The imaging volume constitutes only a small part of the measuring space in which a patient table can be positioned. As has already been stated, it is known to mount a communication means in the form of a mirror on such a patient table.

Also known are MRI apparatus in which said coil system is situated in a non-tubular envelope which is open at its side. In that case the patient to be examined is not situated in a tunnel-shaped space, but in a measuring space which still leaves only a small clearance around the patient.

5 It has been found in practice that it is desirable to realize facilities for extensive communication with and by the patient arranged on the table positioned in the MRI apparatus. However, it is difficult to mount further communication means on the patient table.

10 In order to solve this problem, the MRI apparatus of the kind set forth according to the invention is characterized in that there is provided a carrier which is attached to the patient table at the area where the head of a patient will be situated, in said carrier there being provided said communication means as well as means enabling communication from the outside world with a patient arranged on the table in the measuring space and/or means for enhancing the patient's comfort.

15 Notably one or more means of the following group of means are provided in the carrier:

- means for maintaining audio communication with the patient, for example an intercom system, whereby notably feelings of anxiety can be prevented;
- optical means, such as a mirror or a prism so that the patient can maintain
20 visual contact with the outside world as is desirable notably for children;
- patient observation means which may be of importance when it must be possible to observe the face of the patient, for example because a sedative has been administered to the patient;
- noise suppression means as are often necessary to prevent straining of the ears
25 of a patient; the MRI apparatus usually produces a significant amount of noise during operation;
- patient cooling means and illumination means for enhancing the patient's comfort.

30 For structural reasons the carrier is preferably shaped as an arc or a ring. In order to impart a sense of openness and light to the patient arranged on the table in the measuring space of limited dimensions in the MRI apparatus, the arc-shaped or ring-shaped carrier is made of a transparent material.

These and other aspects of the invention are apparent from and will be elucidated, by way of non-limitative example, with reference to the embodiment described hereinafter and the accompanying drawing. In the drawing:

Fig. 1 shows diagrammatically the general construction of a magnetic resonance apparatus;

Fig. 2 shows a patient table which is provided with the facilities according to the invention and can be positioned in an arc-shaped space of the MRI apparatus.

The magnetic resonance apparatus which is diagrammatically shown in Fig. 1 includes a first magnet system 1 for generating a steady, uniform magnetic field B, a second magnet system 3 (the gradient coil system) for generating magnetic gradient fields, a power amplifier 7 for the gradient coil system 3, and a power supply device 5 for the first magnet system 1. An RF coil 9 serves to generate an RF magnetic alternating field; to this end it is connected to an RF transmitter device which includes an RF source 11. The RF coil 9 can also be used for the detection of spin resonance signals generated by the RF transmitter field in an object to be examined (not shown); to this end, the RF coil is connected to an RF receiver device which includes a signal amplifier 13. The output of the signal amplifier 13 is connected to a detector circuit 15 which is connected to a central control device 17. The central control device 17 also controls a modulator 19 for the RF source 11, the power amplifier 7 and a monitor 21 for image display. An RF oscillator 23 controls the modulator 21 as well as the detector 15 which processes the measuring signals. A cooling device 25 with cooling ducts 27 is provided for the cooling of the magnet coils of the first magnet system. The RF coil 9, being arranged within the magnet systems 1 and 3, encloses an imaging volume 29 which, in the case of an apparatus for medical diagnostic measurements, is large enough to accommodate a patient to be examined, for example the head and the neck of the patient. Thus, a steady magnetic field B, gradient fields for selecting object slices, and a spatially uniform RF alternating field can be generated within the imaging volume 29. The RF coil 9 can combine the functions of transmitter coil and measuring coil; in that case there is provided a separating circuit 14 for separating the forward and the return signal traffic. Alternatively, different coils can be used for the two functions; for example, surface coils then act as measuring coils.

Even though the imaging volume is shown to have a rectangular shape in Fig. 1, in practice it is cylindrical and forms part of a measuring space in the MRI apparatus which is shaped as a tunnel in the present embodiment. A patient table can be positioned in

this tunnel-shaped space in such a manner that the part to be scanned of the body of a patient arranged thereon is situated in the imaging volume.

The patient table is shown in Fig. 2 in which it is denoted by the reference numeral 31. The head of a patient arranged thereon is diagrammatically represented. Around
5 the patient table there is provided an arc-shaped carrier 33 which is rigidly connected thereto and is mounted in such a location that the head of a patient arranged on the patient table lies approximately within the arc-shaped carrier 33. The arc-shaped carrier 33 is made of a transparent material. In the carrier 33 there are provided a loudspeaker 35 as well as an outlet opening 37 for cool air, an illumination system 39, a microphone 41, and a series of lamps 43
10 for illumination which is adjustable through an angle ϕ . Moreover, a camera 45 and a mirror 47 are connected to the carrier 33 at the top. The connections and electrical leads for all of said facilities can be conducted through or along the arc-shaped carrier 33 and underneath the patient table. The facilities 33-47 constitute part of the communication means enabling communication between a patient arranged on the table in the tunnel-shaped space and the
15 outside world, of the communication means enabling communication between the outside world and a patient arranged on the table in the tunnel-shaped space, and of the means for enhancement of patient's comfort.

CLAIMS:

1. A magnetic resonance imaging apparatus which includes a measuring space and a patient table which can be positioned in the measuring space, means being provided so as to enable communication between a patient arranged on the table in the measuring space and the outside world, characterized in that there is provided a carrier which is attached to the patient table at the area where the head of a patient will be situated, in said carrier there being provided said communication means as well as means enabling communication from the outside world with a patient arranged on the table in the measuring space and/or means for enhancing the patient's comfort.
2. A magnetic resonance imaging apparatus as claimed in Claim 1, characterized in that one or more means of the following group of means are provided in the carrier: means for maintaining audio communication with the patient, for example an intercom system; optical means enabling the patient to maintain visual contact with the outside world; patient observation means; noise-suppression means; patient cooling means and illumination means.
3. A magnetic resonance imaging apparatus as claimed in Claim 1 or 2, characterized in that the carrier is shaped as an arc or a ring and is made of a transparent material.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/08971

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01R33/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01R A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 016, no. 298 (C-0958), 2 July 1992 (1992-07-02) & JP 04 082535 A (TOSHIBA CORP; OTHERS: 01), 16 March 1992 (1992-03-16) abstract	1-3
X	US 4 923 295 A (SIREUL JACQUES ET AL) 8 May 1990 (1990-05-08) column 3, line 4 -column 5, line 20; figures 1,2,4	1-3
X	DE 38 44 482 C (BRUKER MEDIZINTECHNIK GMBH) 1 February 1990 (1990-02-01) column 1, line 39 -column 6, line 13; figures 1,3,4	1-3
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Interr. 1st Application No

PCT/EP 00/08971

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

International Application No

PCT/EP 00/08971

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